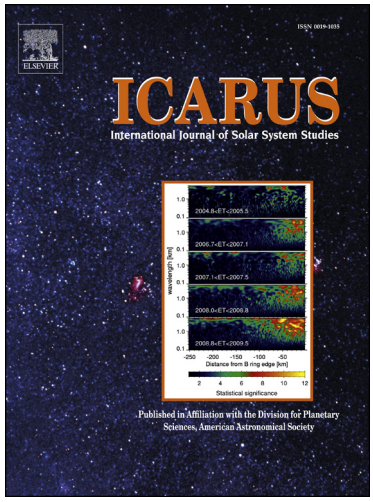

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PII: S0019-1035(14)00235-8
DOI: http://dx.doi.org/10.1016/j.icarus.2014.04.043
Reference: YICAR 11073

To appear in: *Icarus*

Received Date: 24 December 2013
Revised Date: 24 April 2014
Accepted Date: 24 April 2014

Please cite this article as: Krasnopolsky, V.A., Observations of CO Dayglow at 4.7 μm, CO Mixing Ratios, and Temperatures at 74 and 104-111 km on Venus, *Icarus* (2014), doi: http://dx.doi.org/10.1016/j.icarus.2014.04.043

Observations of CO Dayglow at 4.7 μm, CO Mixing Ratios, and Temperatures at 74 and 104-111 km on Venus

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Abstract. The CO dayglow at 4.7 μm on Venus has been observed using the long-slit high-resolution spectrograph CSHELL at NASA IRTF with a resolving power of 4×10^4. The observations covered a latitude range of ±60° at local time of 07:50 at low latitudes. Solar lines in the spectra are used to measure Venus reflectivity which is found to be of 0.077 at 4.7 μm. Intensity ratio of the P2, P1, and R1 lines of the CO dayglow at the fundamental band (1-0) differs from that calculated by Crovisier et al. (2006) and is closer to that expected at local thermodynamic equilibrium. The CO (1-0) dayglow is optically thick, its intensity weakly depends on the CO abundance and it proves poorly accessible for diagnostics of the Venus atmosphere. Six observed lines of the CO dayglow at the hot (2-1) band show a significant limb brightening typical of an optically thin airglow. Vertical intensities of the CO (2-1) band corrected for viewing angle and the Venus reflection are constant at 3.3 MR in the latitude range of ±50° at a solar zenith angle of 64°. Rotational temperatures of the CO (2-1) dayglow should reflect ambient temperature near 111 km. The observed temperatures are slightly higher on the south with a mean value of 203 K. A model of the CO (2-1) dayglow has been improved. The CO (v = 2) molecules are excited by absorption of the sunlight at the CO (2-0) and (3-0) bands at 2.35 and 1.58 μm and photolysis of CO_2 by the solar Lyman-alpha emission. The dayglow is quenched by CO_2, and the calculated mean dayside intensity is 3.1 MR. The weighted-mean dayglow altitude is 104 km. Variations of the dayglow with CO abundance and solar zenith angle are calculated and presented. Then the model results are used to convert the observed dayglow intensities into CO abundances at 104 km. The retrieved CO mixing ratios are constant from 50°S to 50°N with a mean value of 560 ± 100 ppm. The observed values of CO and temperatures are compared and discussed with those in other observations and models. Numerous CO and CO_2 absorption lines in the observed spectra are used to retrieve CO abundances and temperatures at 74 km on Venus. The measured CO mixing ratio is found constant at 40 ppm from 50°S to 30°N with a weak increase to the higher latitudes. The temperature at 74 km is almost constant at 222.6 ± 3.4 K, in perfect agreement with the Venus International Reference Atmosphere (Seiff, A., et al., 1985, Adv. Space Res. 5, 3-58).

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